ESep - *A Novel Low Energy Route to Ethanol Recovery*

Trans Ionics Corporation

21st NREL Industry Growth Forum

October 28-30, 2008

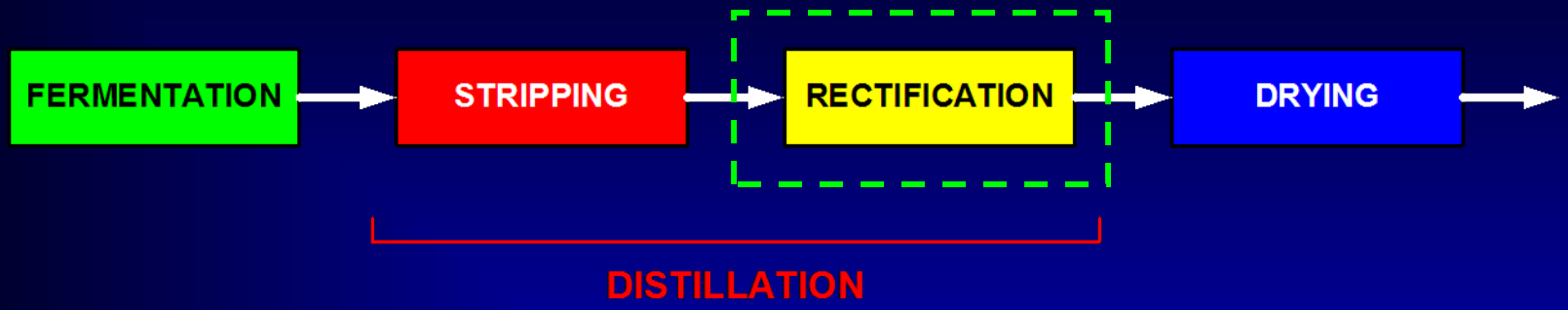
Trans Ionics Corporation

- Incorporated 2000
- Energy-Saving Separation Technology
- Over $3 million committed to R&D
- Seeking $3.5 million early stage financing to launch ESep

The Problem and Opportunity

- 2009 U. S gasoline demand projected to be **145 billion gallons**
- RFS requires use of **36 billion gallons** of biofuels to by 2022
- U. S. ethanol industry under heavy financial pressure and is consolidating
- New technology needed to reduce the cost of ethanol

Current Ethanol Process



Disadvantages of Distillation

- **High Capital Costs**
  - Typically three large stainless steel distillation towers
  - Stainless steel heat exchangers
  - Price of stainless up 400% in last six years
- **High Operating Costs**
  - 280 MMBTU/hr energy consumed (100 MGPY ethanol)
  - Mole sieve drying adds to energy costs
  - Energy costs up significantly with price of crude oil

The ESep Concept

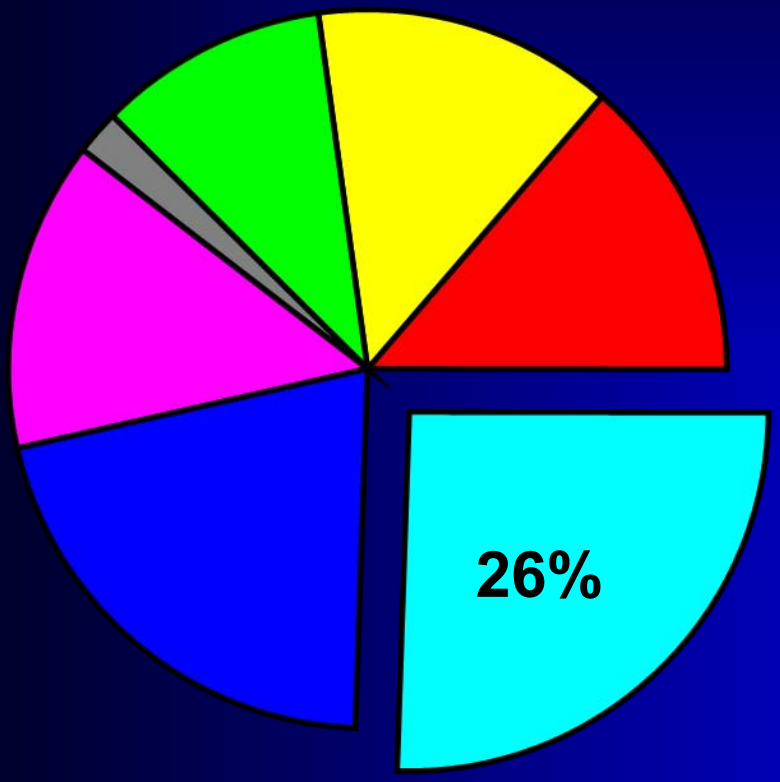
"ESep is a modular, low-energy process for the recovery of ethanol from fermentation broth with an estimated reduction of up to 60% in both capital and operating costs versus conventional distillation. Use of non-stainless steel components also results in a substantial reduction in construction time"

Bill of Materials (20 MMGPY Retrofit Skid)	
	($000)
Skid (structural steel)	$140
Extraction Unit (PVC)	$200
Heat exchangers (low T)	$ 10
Pumps	$100
Piping	$ 25
Instrumentation/Safety	$ 25
Assembly/Shipping	$ 50
Estimated Total Cost	**$550**
Gross Margin	**56%**

Two Ways to Apply ESep

- **Retrofits**
  - Primarily applicable to existing ethanol plants
  - Uses existing stripper and mole sieve dryer
  - Replaces rectifier and side stripper
  - Non-stainless materials
  - Reduces overall energy consumption by 28%
  - Estimated payback to customer is 16 months
- **New Plants**
  - Applicable to new ethanol plants (corn, sugar and cellulosic)
  - Replaces whole distillation train and mole sieve dryer
  - Non-stainless materials
  - Reduces overall energy consumption by >60%
  - Significantly lower capital cost than new stainless system

U.S. Ethanol Market is $14 Billion/yr



Ethanol Producer	Annual Production (MGPY)
VeraSun	1,420
POET	1,396
ADM	1,070
Aventine	207
101 - 200 MGPY	1,444
51 - 100 MGPY	2,163
2 - 50 MGPY	2,645
TOTAL US 2008	10,345

Source: RFA website (http://www.ethanolrfa.org/industry/locations/)

Retrofit Competition

	ESep	Vaperma	Whitefox
Liquid phase operation	Yes	No	No
Removes ethanol vs water	Yes	No	No
Works on all feed alcohol contents	Yes	No	No
Low temperature (saves energy)	Yes	No	No
Lower capital cost than distillation	Yes	No	No

- **Traditional Ethanol Technology Distributors**
  - Includes ICM, Fagen, POET, Delta-T, Vogelbusch
  - Continually improving systems (still stainless steel)
  - Large and well-financed

Management and Advisors

- **Dr. Robert C. Schucker, President and CEO**
  - 23 year veteran of **Exxon Research** (retired 2000)
  - 35 years experience (separations expert), 44 patents
- **Douglas R. Courville, Management Advisor**
  - Co-owner/co-founder ENPAL LC, 42 years experience
- **C. Douglas Wilson, Financial Advisor**
  - Harvard MBA, 35 years financial experience
- **Dr. Allan J. Jacobson – University of Houston**
  - Director of the Texas Center for Superconductivity
  - 45 patents and over 300 publications
- **Dr. Andrew R. Barron – Rice University**
  - Co-Director Rice Alliance for Technology and Entrepreneurship
  - 10 patents and over 330 publications

ESep Retrofit Business Model

(20 MGPY Skid-Mounted Units)

- Sales Revenue Assumptions
  - Selling Price: $1,250,000 (> 50% Gross Margin)
  - Multiple units scale linearly to achieve desired rate
  - Significant Incentive to Operators to Apply ESep
    - $0.07/gal ethanol produced saved for operators
    - Reduces distillation operating cost by 30%
- Processing Fee Revenue Assumptions
  - Fee of $0.02/gal ethanol produced
  - Similar to running royalties in the oil and gas business

Retrofit Savings are Significant

Capacity (MMGPY)	20		
ESep Capex	**$1,250,000**		
Assumed Price of Natural Gas ($/MMBTU)	$5.75	$7.75	$9.75
Conventional Disitllation			
Heat Load (MMBTU/hr)	56.4	56.4	56.4
Cooling Water Load (MMBTU/hr)	46.4	46.4	46.4
Opex ($/yr)	**$3,198,556**	**$4,186,684**	**$5,174,812**
ESep			
Heat Load (MMBTU/hr)	39.6	39.6	39.6
Cooling Water Load (MMBTU/hr)	22.4	22.4	22.4
Opex ($/yr)	**$2,167,329**	**$2,861,121**	**$3,554,913**
Savings From Using ESep ($/yr)	**$1,031,227**	**$1,325,563**	**$1,619,899**
Processing Fee ($/yr)	$400,000	$400,000	$400,000
Net Savings ($/yr)	**$631,227**	**$925,563**	**$1,219,899**
Average Payback Period (Months)	**24**	**16**	**12**

Projected Retrofit Financials

	Fiscal Year				
($000)	1	2	3	4	5
Units Sold	0	2	6	15	30
Revenues	-	$2,500	$9,500	$24,950	$52,700
Gross Profit	$(939)	$(289)	$5,600	$15,950	$34,700
Gross Profit %	-	-	59%	64%	66%
EBITDA	$(1,392)	$(976)	$3,225	$10,336	$24,160
Net Profit	$(1,361)	$(929)	$2,974	$6,090	$14,141
Net Profit %	-	-	31%	24%	27%

- Revenue does not include any new units to replace entire distillation train
- Revenue does not include any sales outside United States (Brazil)
- Revenue does not include any sales for propanol and butanol

Use of Funds

Build/test 1 MGPY Demo Unit (40% Cont.)	$1,000,000
Build/deliver first 20MGPY Comm'l Unit	$1,700,000
Working Capital to Break Even in Year 3	$800,000
Total Funding Required	**$3,500,000**

Important Milestones

Completed

- Laboratory Work
- Process Computer Simulations
- Selection of Engineering Design and Fabrication Firms
- Identification of Initial Potential Customers

Year 1

- $1.5M funding
- Design/build 1 MGPY demo
- Letters of intent from potential customers
- Test demo at customer site
- Design 20 MGPY commercial unit
- PO for one (1) commercial unit

Year 2

- $2.0M funding
- PO for second unit
- Build/deliver first two commercial retrofit units
- Ramp up sales and marketing
- Initiate design of system to replace entire distillation train
- POs for four units

ESep Success Factors

- Energy prices are expected to rise
- Desire in USA to “lessen our dependence on foreign oil”
- Alternative fuels are one avenue to meet this goal
  - RFS mandates 36 billion gallons by 2022
- **ESep is viable alternative to distillation**
  - Reduced energy consumption
    - ~30% in retrofit units ($0.07/gallon)
    - ~60 % in new units ($0.14/gallon)
  - Reduced capital cost
    - Non-stainless steel construction
    - Projected to cost less than half of competitors
    - Small footprint